

The Swedish National Electrical Safety Boards Regulations

regarding design and erection of electrical installations and general
advice when applying these regulations

The original Swedish text shall take precedence should any doubt concerning
interpretation arise.



The Swedish National Electrical Safety Boards Regulations regarding design and erection of electrical installations and general advice when applying these regulations

Contents

Chapter 1	General Provisions	3
	1–2 §§ Area of application	
	3 § Good electrical safety practice	
	4 § Design and erection in compliance with Swedish Standards	
	5 § Design and erection not in compliance with Swedish Standards	
	6–7 §§ Electrical installations designed and erected in compliance with regulations previously in force	
	8 § Verifications	
	9 § Exceptions to these Regulations	
Chapter 2	Definitions	4
Chapter 3	General Safety Requirements	5
	1 § Basic safety requirements	
	2–5 §§ Protection against electric shock	
	6 § Protection against thermal and mechanical effects	
	7 § Protection against overvoltage	
	8 § External influences	
	9 § Identification	
	10 § Operation and maintenance	
Chapter 4	Special Safety Requirements for Low Voltage Installations	6
	1 § Contents	
	2 § Protection against electric shock	
	3 § Public mains distribution network	
	4–5 §§ Child safety	
	6 § Temporary electrical installations	
Chapter 5	Special Safety Requirements for High Voltage Installations	7
	1 § Contents	
	2–3 §§ Protection against electric shock	
	4–8 §§ Automatic disconnection of supply in the case of earth faults in non-directly-earthed systems	
	9 § Automatic disconnection of supply in the case of earth faults in directly-earthed systems	
Chapter 6	Special Safety Requirements for Overhead Lines	9
	1 § Contents	
	2 § High voltage overhead lines with open conductors within detail planned areas	
	3–4 §§ Clearances for overhead lines to ground	
	5 § Clearances for overhead lines to buildings	
	6 § Clearances for overhead lines to traffic routes	
	7 § Clearances for high overhead lines to certain locations	

8 § Clearances for overhead lines to areas where combustible materials are stored or to areas with an explosion hazard

Coming into Force and Transition Stipulations 11

The Swedish National Electrical Safety Board's general advice on the use of these regulations on how electrical heavy current installations are to be implemented 12

The Swedish National Electrical Safety Board

Statute book

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The Swedish National Electrical Safety Boards Regulations regarding design and erection of electrical installations and general advice when applying these regulations;

ELSÄK-FS
2004:1

adopted on 29 January 2004.

Under authority of Chapter 1 2 § Statute (1957:601) on electrical installations, the Swedish National Electrical Safety Board brings the following Regulations into force and determines the following general advice.

Chapter 1 General Provisions

Area of application

1 § These regulations apply to the design and erection of electrical installations. The regulations apply to both the selection and installation of electrical equipment.

2 § These regulations do not apply to electrical installations in aircraft, for electric railway, tramway, underground train, and trolleybus operation, in vehicles for electric railway, tramway, underground train, and trolleybus operation, in other vehicles including towed vehicles, on vessels including leisure boats, or on other devices.

Good electrical safety practice

3 § An electrical installation shall comply with the general safety requirements in Chapter 3. It shall be designed and erected applying good electrical safety practice so as to provide adequate safety for persons, domestic animals and property against injury or damage due to electricity.

Design and erection in compliance with Swedish Standards

4 § Unless otherwise indicated, an electrical installation shall be considered to comply with good electrical safety practice when designed and erected in compliance with Swedish Standards and with the appropriate parts of the special safety requirements in Chapters 4 through 6 (4 to 6 inclusive).

Design and erection not in compliance with Swedish Standards

5 § An electrical installation which is not designed and erected wholly or partly in compliance with Swedish Standards shall comply with the general safety requirements in Chapter 3. The considerations which are the basis for the chosen design and erection shall be documented. The design and erection shall comply with the appropriate parts of the special safety requirements in Chapters 4 through 6 (4 to 6 inclusive).

Electrical installations designed and erected in compliance with regulations previously in force

6 § In the case of rebuilding or extension of an electrical installation, the regulations in force at the time of rebuilding or extending shall be complied with.

Exceptions apply to the following requirements:

- The requirement for protective earthing of an extension of an electrical installation within an existing dwelling room or a comparable dry type room with an insulating floor:
- In these types of rooms, the exposed conductive parts need not be connected to a protective conductor if the already existing exposed conductive parts are not connected to the protective conductor and the installation was completed before 1 January 1994.
- The requirement for installing a residual current device (RCD) with the extension of an electrical installation within existing dry type rooms in dwellings, primary schools, afterschool centres, and nursery school/day nurseries:
- In these types of rooms an electrical installation may be extended without the installation of a residual current device (RCD) if the existing installation is designed and erected in compliance with ELSÄK-FS 1994:7¹ or earlier applicable regulations.
- The requirement concerning the sensitivity of earth fault protection for high voltage overhead lines with bare conductors for a system voltage not exceeding 25 kV:
- These overhead lines may be extended or rebuilt with bare conductors without the requirement of the sensitivity of the earth fault protection being changed.

7 § These regulations shall be applied when the use or conditions of an existing electrical installation are changed in such a way that has considerable implications for electrical safety.

Verifications

8 § Before a new, altered or extended electrical installation is brought into operation, it shall be checked to ensure that it provides adequate safety against injury or damage due to electricity.

Exceptions to the Regulations

9 § The Swedish National Electrical Safety Board can grant exceptions to these regulations.

Chapter 2 Definitions

1 § For the purpose of these regulations, the following definitions apply:

1. **public mains distribution network:** a distribution network which demands a licence for network operating,
2. **closed electrical operating area:** a room or location for operation of electrical installations and equipment to which access is intended to be restricted to skilled or instructed persons or to lay personnel under the supervision of skilled or instructed

¹ The Swedish National Electrical Safety Board Regulation (ELSÄK-FS 1994:7) on installation and maintenance of electrical installations.

persons, e.g. by opening a door or removing a barrier which requires the use of a key or tool, and which is clearly marked by appropriate warning signs.

3. **skilled person:** person with relevant education, knowledge and experience to enable him or her to analyse risks and to avoid hazards which electricity could create,

4. **obstacle:** a part preventing unintentional direct contact, but not preventing direct contact by deliberate action,

5. **high voltage installation:** an installation with a nominal voltage exceeding 1 000 V a.c. or 1 500 V d.c.,

6. **instructed person:** person adequately advised by skilled persons to enable him or her to avoid dangers which electricity may create,

7. **overhead line:** An electric line whose conductors are supported above ground, generally by means of insulators and appropriate supports. Certain overhead lines may be constructed with insulated conductors,

8. **low voltage installation:** an installation with a nominal voltage not exceeding 1 000 V a.c. or 1 500 V d.c.,

9. **nominal voltage:** voltage by which an installation or part of an installation is designated,

10. **live part:** conductor or conductive part intended to be energized in normal operation, including a neutral conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor,

11. **electrical installation:** an installation for a voltage, current, or frequency which can be hazardous for persons, domestic animals, or property,

12. **system voltage:** the line to line voltage in an installation, i.e. the voltage between two phases, even where the connection is implemented between phase and neutral conductors,

13. **exposed conductive part:** a conductive part of electrical equipment, which can be touched and which is normally not live, but which can become live when basic insulation fails,

14. **socket:** a fixed or moveable means of connection equipped with outlet contact sockets via which power can be taken out, i.e. wall, floor, and lighting sockets.

Chapter 3 General Safety Requirements

Basic safety requirements

1 § An electrical installation shall be designed and erected in such a way that it provides adequate safety under normal circumstances, and in reasonably predictable fault handling.

Protection against electric shock

2 § An electrical installation shall be designed and erected in such a way that persons and domestic animals are protected against the dangers of touching live parts.

3 § An electrical installation shall be designed and erected in such a way that persons and domestic animals are protected against the dangers of contact with exposed conductive parts which have become live due to a fault.

4 § An overhead line shall be designed and erected in such a way that its construction and location to an adequate extent guards against dangers to persons, domestic animals and property. It shall be routed with an adequate clearance to ground, vegetation, other conductors/lines/wires/pipes, roadways and buildings, etc.

5 § A closed electrical operating area shall be adequately enclosed or fenced.

Protection against thermal and mechanical effects

6 § An electrical installation shall be designed and erected in such a way that it does not carry a risk of injury or damage to persons, domestic animals or property due to high temperatures, arcing, or mechanical stress caused by normal operating currents or by overcurrents.

Protection against overvoltage

7 § An electrical installation shall be designed and erected in such a way that it can withstand normal voltages which can be expected to occur in the installation.

An electrical installation shall be designed and erected in such a way that it provides adequate safety for persons, domestic animals and property, in the case of leakage between live parts which belong to separate circuits operating at different voltages.

External influences

8 § The design and erection of an electrical installation shall be appropriate for the external environmental conditions.

Identification

9 § An electrical installation shall be clearly marked and equipped with adequate documentation to enable safe operation and maintenance of the different parts of the installation. The documentation shall be in Swedish unless some other language is more suitable from the safety point of view.

Operation and maintenance

10 § An electrical installation shall be designed and erected in such a way that work and standard operational procedures can be carried out safely.

Chapter 4 Special Safety Requirements for Low Voltage Installations

Contents

1 § This chapter specifies certain requirements for low voltage installations taking Swedish conditions into account.

Protection against electric shock

2 § In electrical installations the use of the “non-conducting environment” protection method is not permitted as protection against electric shock in the case of indirect contact, unless special conditions make this method necessary.

Public mains distribution network

3 § Low voltage public mains distribution networks shall be type TN systems. The PEN conductor shall be earthed near to the power source and, in the case of networks constructed as overhead lines, additionally at appropriate points of the periphery of the network.

Child Safety

4 § Mains sockets shall either be provided with shutters or located/installed in such a way that the risk of accidents involving children is reduced.

5 § In a building or part of a building used as a dwelling, primary school, after-school centre, or nursery school/day nursery a residual current device (RCD) with a rated trip current of 30 mA maximum shall be installed as additional protection for sockets with a rated current of 16 A maximum where protection against electric shock in the case of indirect contact is a requirement.

Sockets are permitted to be exempt from this protection in places where disconnection of the supply could have serious consequences.

Temporary electrical installations

6 § In temporary electrical installations, sockets and permanently connected handheld electrical equipment with a rated current of 16 A maximum shall either be

- protected by a residual current device (RCD) with a rated current of 30 mA maximum,
- or fed via SELV,
- or fed individually from a safety isolating transformer.

Where protection against electric shock in the case of indirect contact is achieved by automatic disconnection of the power supply, the disconnection shall occur so rapidly that touch voltages exceeding 25 V a.c. or 60 V d.c. do not remain long enough to be a hazard to persons.

Chapter 5 Special Safety Requirements for High Voltage Installations

Contents

1 § This chapter specifies certain requirements for high voltage installations taking Swedish conditions into account.

Protection against electric shock

2 § Exposed conductive parts shall be earthed. Extraneous conductive parts which by faults, induction, or influence could become live and be a hazard to persons, domestic animals or property shall also be earthed. Outside closed electrical areas

equipments and cables shall either be constructed with an earthed intermediate shield or be protected against unintentional direct contact by their position. An earthed intermediate shield means a metal enclosure for equipment and screening for cables.

3 § Protection against direct contact by means of obstacles is only permitted in closed operating areas. Rails, chains, and ropes are not permitted as obstacles.

Automatic disconnection of supply in the case of earth faults in non-directly-earthed systems

4 § An electrical installation shall be designed and erected in such a way that a single or multipole earth fault is disconnected rapidly and automatically. An exception applies to an electrical installation for a system voltage not exceeding 25 kV which does not include any overhead line. In this particular case a single pole earth fault is permitted to only initiate an alarm automatically.

5 § A high voltage installations which includes

- an overhead line with bare conductors of reinforced construction,
- an overhead line with plastic sheathed open conductors, or
- an overhead line with non-metalclad aerial bundled conductors

shall have earth fault protection with the highest possible sensitivity for detection of earth faults. Tripping shall be initiated for resistances up to 5 000 ohms.

6 § A high voltage installation for a system voltage not exceeding 25 kV which includes an overhead line of some other type than that stated in 5 § shall have earth fault protection installed such that tripping shall be initiated for resistances up to 3 000 ohms. Within an area which is not detail planned, this type of installation may include a few spans of overhead line with plastic sheathed open conductors.

7 § The permitted voltages of such earthed parts in installations for a system voltage not exceeding 25 kV in which earth faults can occur are given in Table 1.

Table 1 Maximum permitted voltages for earthed parts

Part of installation	Maximum permissible voltages for single pole earth faults		
	Disconnected automatically within		Initiating an alarm automatically
	2 seconds	5 seconds	
Protection conductor and PEN conductor which belong to some other network connected via a transformer in which the neutral point is directly earthed (TN system) – with common earthing – with separate earthing	100 V	100 V	50 V
	200 V	200 V	100 V
Exposed conductive parts in closed electrical operating areas or in places where people may often be present	400 V	300 V	100 V
Other parts	800 V	600 V	200 V

8 § In installations with a system voltage exceeding 25 kV, the touch and step voltages which occur on earth faults shall be reduced. Alternatively the voltages of earthed parts which the earth fault current causes shall be limited to the levels given in Table 1.

Automatic disconnection of supply in the case of earth faults in directly earthed systems

9 § A high voltage installation which is included in a directly earthed system shall be designed and erected in such a way that earth faults shall be automatically disconnected within a maximum of 0.5 seconds and the touch and step voltages which occur on earth faults shall be reduced .

Chapter 6 Special safety requirements for overhead lines

Contents

1 § This chapter specifies certain requirements for overhead lines taking Swedish conditions into account.

High voltage overhead lines with open conductors within detail planned areas

2 § Within a detail planned area, a high voltage overhead line with open conductors shall be designed and erected as a break-proof line. An overhead line with a system voltage not exceeding 25 V may be designed and erected with a reinforced construction.

Clearances for overhead lines to ground

3 § The minimum clearances to ground of conductors shall not be less than the figures given in Table 2.

Table 2 Minimum clearances to ground in metres

Line type and system voltage	Detail planned area	Area not detail planned
Overhead line ≤ 1 kV	4.5	4.5
Overhead line without metalclad or screened cable > 1 kV	6*	6
Overhead line with metalclad or screened cable > 1 kV	6*	4.5
Phase conductor in overhead line with open conductors > 1 and ≤ 55 kV	7	6
> 55 kV	7 + S	6 + S
Overhead earth wire	6*	4.5*

The figures marked with * apply to free space covering all load cases. The other figures apply at maximum conductor temperature at no wind. S indicates a voltage dependent addition. See also General advice.

4 § Where an overhead line with a system voltage not exceeding 1 kV enters a building, the clearances to ground may be reduced. For an overhead line with open conductors or with aerial bundled conductors, the minimum clearance shall be 3,5 metres.

In the case of an overhead line with a system voltage exceeding 1 kV, the clearances to ground may be reduced on entry into a building only if the line consists of metalclad or screened cable.

Clearances for overhead lines to buildings

5 § Low voltage overhead lines may be routed over or adjacent to buildings provided that they cannot be reached from an open window, balcony or roof without the use of special aids.

High voltage overhead lines shall not be routed over buildings. An exception applies to overhead lines with catenary wires and overhead lines with metalclad aerial bundled conductors, and, within closed electrical areas, to overhead lines with open conductors.

High voltage overhead lines shall be routed in such a way that the horizontal clearance to a building or part of a building shall be at least as given in Table 3. An exception applies to overhead lines with metalclad or screened cables.

Table 3 Minimum horizontal clearances to buildings in metres.

Area	System voltage	At no wind	At maximum swing out angle of the conductors
Detail planned area	> 1 and ≤ 55 kV	5	3
	> 55 kV	10	3 + S
Area not detail planned	> 1 and ≤ 55 kV	5	3
	> 55 kV	5 + S	3 + S

Table 3 does not apply to entry into a building. S indicates a voltage dependent addition. See also General advice.

Clearances for overhead lines to traffic routes

6 § Overhead lines shall be installed with adequate clearances to traffic routes. See Table 4.

Table 4 Minimum clearances to traffic routes in metres

Line type and system voltage	Roads		Railways		Navigable waterways
	Public roads	Other roads	Nonelectrified railway	Electrified railway	Normal high water level
Overhead line ≤ 1 kV	6*	6*	8*	Not permitted	6*
Overhead line > 1 kV	6*	6*	7*	The minimum clearances in every individual case is determined in consultation with the proprietor of the railway	7
Phase conductor in overhead line with open conductors > 1 and ≤ 55 kV	7	6*	8		7
> 55 kV	7 + S	(6 + S)*	8 + S		7 + S
Overhead earth wire	6*	6*	7*		7

The figures marked with * apply to free space covering all loading cases. The other figures apply at maximum conductor temperature at no wind. S indicates a voltage dependent addition. See also General advice.

An overhead line within a navigable waterway area shall be erected at a minimum clearance to the high water level either as specified by the Swedish Maritime Administration for every individual case or as given in the Concession Agreement.

Overhead lines shall nevertheless always be erected at least at the minimum clearances given in Table 4.

Where an overhead line crosses an electrified railway, it shall be installed at a height determined by the Swedish National Electrical Safety Board after consultation with the proprietor of the railway.

Clearances for high voltage overhead lines to certain locations

7 § A high voltage overhead line, with the exception of metalclad or screened cables with catenary wires, shall be installed with an adequate clearances to the following locations:

- school playgrounds,
- sportsfields
- racecourses/trotting tracks
- shooting ranges
- official campsites
- bathing/swimming places and playparks
- spectator areas

An overhead line may be routed over other leisure activity areas, e.g. golf courses and playing fields without spectator areas, provided that damage to the line is prevented and the line has been constructed as a break-proof line or, at a system voltage not exceeding 25 kV, as a line with a reinforced construction.

Clearances for overhead lines to areas where combustible material is stored or to areas with an explosion hazard

8 § An overhead line shall be routed at an adequate clearance to areas where combustible material is stored or to areas with an explosion hazard.

Coming into force and Transition Stipulations

These Regulations will come into force on 1 July 2004.

Sections A and B in the Swedish National Electrical Safety Board Regulations (ELSÄK-FS 1999:5) on installation and maintenance of electrical installations will cease to apply on 1 July 2006. Exceptions apply for electrical track or trolleybus installations. For these types of installations, the whole of the Swedish National Electrical Safety Boards Regulations (ELSÄK-FS 1999:5) will continue to be in force.

GUNNEL FÄRM

Horst Blüchert

The Swedish National Electrical Safety Boards general advice² on the use of these regulations regarding design and erection of electrical installations

Chapter 1

- Ref. 1 §** When selecting equipment, The Swedish National Electrical Safety Boards Regulations (ELSÄKFS 2000:1) on certain electrical equipment shall be applied. Additional requirements for equipment for use within potentially explosive atmosphere are specified in The Swedish National Electrical Safety Boards Regulations (ELSÄK-FS 1995:6) on electrical equipment in explosive atmospheres.
- Ref. 2 §** The requirements on how electrical installations for the excepted installations shall be designed and erected are dealt with in other frameworks.
- Other vehicles including towed vehicles includes, for example, motor caravans and caravans.
- Other devices includes such things as machines, lifts, cranes, and wind generators.
- Ref. 3 §** Design and erection in compliance with good electrical safety practice reflects the level of safety that has been established within the field of electrical safety. Good electrical safety practice is made up of the Regulations regarding design and erection of electrical installations and of established standards.
- Ref. 4 and 5 §§** The Swedish National Electrical Safety Board has the power to prohibit the use of an electrical installation or require rectifications of an electrical installation which appears to create a hazard from the electrical safety point of view.
- Ref. 5 §** The documentation requirement applies to the considerations involved to comply with Chapter 3 and do not concern Chapters 4 through 6. The documentation may consist of references to the documents which describe the chosen design and erection, e.g. established standards. In other cases, documentation on the risk assessment which forms the basis of the chosen design and erection will be required.
- Ref. 8 §** Instructions for verifications are specified in SS 436 46 61 for low voltage installations and in SS 421 01 01 for high voltage installations.

² General recommendations comprises such general advice on the use of a statute that indicate to some extent how someone may or ought to act..

Chapter 3

- Ref. 2 and 3 §§** Electric shock can occur:
- when touching bare live parts (direct contact)
 - at high voltage, within the danger zone,
 - when touching a conductive part which has become live under fault conditions (indirect contact), and
 - when touching a conductive part which has become live due to induction (voltage resulting from electromagnetic effect) or influence (voltage resulting from electrostatic effect).
- Ref. 4 §** Overhead lines with different proprietors should be routed on separate poles. When routed on the same poles, responsibilities such as boundaries and maintenance must be predefined and documented by the proprietors.
- Ref. 7 §** Lightning protection is dealt with in Swedish Standard SS 436 40 00 section 443.
- Ref. 8 §** External influences mean
- the surrounding environment to the extent that it has an influence on the electrical installation,
 - the needs to be fulfilled by the electrical installation and the activities to be carried out adjacent to the electrical installation or
 - in case of installations in buildings, the construction of the building with regard to its fire resistance rating and choice of building materials.

Chapter 4

Design and erection of low voltage electrical installations is covered in Swedish Standard SS 436 40 00.

- Ref. 5 §** A Residual current device (RCD) shall be used to provide protection in the case of faults in the protection measures taken or of lack of care by the user.
- Ref. 6 §** A temporary electrical installation is considered to be an installation:
- on a building or demolition site,
 - in exhibitions, displays and stalls,
 - in pleasure parks, tivolis and circuses.

Swedish Standard SS 436 40 00 deals with these types of installations in section 704, 711, and 740.

SELV means protection against electric shock by using an extra-low voltage from a protective current source and with the circuit separated from other circuits and earth.

Chapter 5

The design and erection of high voltage electrical installations is covered in Swedish Standard SS 421 01 01.

Ref. 8 and 9 §§ The touch and step voltages in a non-directly-earthed system are considered to be reduced if they do not exceed 150 V on an earth fault which is disconnected within 5 seconds or do not exceed 240 V on an earth fault which is disconnected within 2 seconds. The touch and step voltages in a directly earthed system are considered to be reduced if the voltages arising within a closed electrical area or its surroundings do not exceed 600 V. The voltages can be determined as the product of a resistance of 3 000 ohms and the current which flows through this resistance in the case of an earth fault.

Chapter 6

The design and erection of overhead lines for a system voltage exceeding 45 kV are covered in Swedish Standard SS-EN 50 341.

The design and erection of overhead lines for a system voltage not exceeding 45 kV are covered in Swedish Standards SS 436 01 01 – 06 and SS 421 07 10.

Ref. 3, 5 and 6 §§ In Tables 2 through 4 the voltage dependent addition is 0.7 cm in a non-directly-earthed system and 0.5 cm in a directly earthed system for each kV that the system voltage exceeds 55 kV.

Table 5 Examples of voltage dependent addition (S) in metres

System voltage kV	Voltage dependent addition (S)	
	Directly earthed system	Non-directly-earthed system
77		0.2
132	0.4	
220	0.8	
400	1.7	

The figures are rounded

Ref. 7 § An adequate clearance means normally that the horizontal clearance to a live conductor is not less than 20 m. In the case of shooting ranges, a line is considered to be routed at an adequate clearance if its horizontal clearance is:

- at least 10 metres behind the firing area and parallel to the shooting range, and
- at least 20 metres behind the target area.

Ref. 8 § The clearances given in Table 6 below provide normally adequate safety in an area with an explosion hazard.

Table 6 Minimum horizontal clearance in metres from a live conductor to an area with an explosion hazard.

Highest voltage for equipment kV	Clearances to a hazardous area with combustible material with regard to the risk of electrostatic charge	Clearances to a store containing explosives
12.0 –72.5	15	50
82.5	30	50
145 –170	30	100
245	45	100
420	60	100

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regarding design and erection of electrical installations and general advice when applying these regulations.

1. utförande - design and erection (IEC 60 364)
2. råd -advice
3. tillämpningsområde - area of application
4. kontroll före ibrukt. - verifications (IEC 60 364 del 6)
5. yttre påverkan - external influences (436 40 00 = IEC 60 364 del 5)
6. skötsel - operation and maintenance (EN 50110 och översättning av 1997:9)
7. distributionsnät - mains distribution network
8. elmateriel - electrical equipment (IEC 60 364)
9. anordning - device (IEC 60 364)
10. husdjur - domestic animals
11. utsatt del - exposed conductive part (IEV and IEC)
12. jordfelsbrytare - residual current device (RCD) (IEV and IEC)
13. oisolerad ledare - bare conductor (EN 50 341)
14. driftrum - closed operating area (HD 637)
15. isolerad miljö - non-conducting environment (IEC 60 364 part 4)
16. uttag med petskydd - socket with shutters (IEC 60 884)
17. främmande ledan. del - extraneous conductive part (IEV and IEC)
18. hinder - obstacle (IEV and IEC)
19. förstärkt utförande - reinforced construction (EN 50 341)
20. plastbelagd ledare - plastic sheathed conductor (EN 50 341)
21. hängspiralkabel - aerial bundled conductors
22. brottsäker - break-proof
23. luftledning - overhead
24. linefriledning - overhead line with open conductors
25. oisolerad friledning - overhead line with bare conductors
26. isolerad friledning - overhead line with plastic sheathed open conductors
27. hängspiralkabelledning - overhead line with aerial bundled conductors
28. hängkabelledning - overhead line with catenary wire
29. brandfarlig vara - combustible materials



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